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SUBSTANTIVE THEMES SELECTED FOR DETAILED CONSIDERATION: CONTRIBUTION OF NEW AND RENEWABLE SOURCES OF ENERGY TO DECENTRALIZED ENERGY SYSTEMS AND TO SPECIFIC MULTI-PURPOSE MEDIUM- TO LARGE-SCALE APPLICATIONS, AND PROMOTION OF RAPID AND EFFECTIVE TRANSFER OF TECHNOLOGY IN THE FIELD OF NEW AND RENEWABLE SOURCES OF ENERGY TO DEVELOPING COUNTRIES, INCLUDING THE ROLE OF JOINT VENTURES IN THE FRAMEWORK OF NORTH/SOUTH AND SOUTH/SOUTH COOPERATION, IN THE FULFILMENT OF THE GOALS AND OBJECTIVES OF THE NAIROBI PROGRAMME OF ACTION, WITH A VIEW TO TAKING DUE ACCOUNT OF THE POTENTIAL CONTRIBUTION OF THOSE SOURCES TO SUSTAINABLE AND ENVIRONMENTALLY SOUND DEVELOPMENT IN ALL COUNTRIES

Contribution of new and renewable sources of energy to decentralized systems and multi-purpose medium- to large-scale applications, and the promotion of rapid and effective transfer of technology

Report of the Secretary-General

* A/AC.218/1992/1.

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INTRODUCTION

1. In its resolution 1(V), the Committee on the Development and Utilization of New and Renewable Sources of Energy decided to include, for detailed consideration at its sixth session, two themes: the contribution of new and renewable sources of energy to decentralized energy systems and to multi-purpose medium- to large-scale applications; and the promotion of rapid and effective transfer of technology in the field of new and renewable sources of energy to developing countries, including the role of joint ventures in the framework of North/South and South/South cooperation, in the fulfilment of the goals and objectives of the Nairobi Programme of Action, with a view to taking due account of the potential contribution of those sources to sustainable and environmentally sound development in all countries. 1/

2. In the same resolution, the Committee also requested the Secretary-General to prepare a report for consideration by the Committee at its sixth session on the activities of the United Nations system in regard to the theme, in order to facilitate a more effective exchange of information and experience.

3. The present report is submitted in response to that request. It should be noted, however, that the two themes selected by the Committee - especially the first one - are all-embracing. Consequently, all of the activities of the United Nations system could be regarded as a contribution to the theme. In its decision 1(V) the Committee approved among the documents to be prepared for its sixth session a report of the Secretary-General on the activities being carried out by the entities of the United Nations system in the field of new and renewable sources of energy, including new project proposals and an update of existing ones, together with information on the status of their implementation. (That report is contained in document A/AC.218/1992/6.)

4. The present report focuses on those activities of the United Nations system which contribute directly to the application of new and renewable energy technologies at the country and/or regional levels. Most of the activities were carried out during the second half of the 1980s. Whenever available, planned activities are also noted.

I. CONTRIBUTION OF NEW AND RENEWABLE SOURCES OF ENERGY TO DECENTRALIZED ENERGY SYSTEMS AND MULTI-PURPOSE MEDIUM- TO LARGE-SCALE APPLICATIONS

A. Solar

5. The United Nations system has executed the largest number of activities in the area of solar energy, compared to the other sources of new and renewable energy. The activities have been taking place since the early 1980s, with a noticeable increase in recent years; most have been in the area of solar photovoltaics.

6. The regional commissions have been mostly involved in research, demonstration, training and planning. The Economic Commission for Africa (ECA) has been supporting the African Regional Centre on Solar Energy on technical, managerial and economic matters. The Economic and Social Commission for Western Asia (ESCWA) has promoted the application of low-cost desalinization techniques and pumping facilities, including the use of solar energy for rural applications.

7. The Department of Technical Cooperation for Development has executed a variety of programmes in solar energy, particularly in the solar photovoltaic area. In China, it established a solar heating and cooling experimental centre at the Gansu National Energy Research Institute by supplying and installing the necessary instruments and equipment. The second phase of the project, which is expected to begin in 1992, will assist in the design and development of practical photovoltaic systems based on the special conditions of western China and will facilitate their broad application. In Mongolia, the Department was involved in the production of solar photovoltaic modules from imported silicon wafer. A market for domestic photovoltaic lighting kits for nomadic herdsmen was also established. A similar project was carried out in Cuba, where the Department assisted in the production of polycrystalline silicon from quartz. The polycrystalline silicon was used as a feedstock for obtaining the single-crystal silicon required for solar photovoltaic systems and the electronics industry. The Department assisted the Research Institute for the Electrotechnical Industry (Hungary) in improving its technologies for the manufacture of solar photovoltaic modules. This is expected to result in the establishment of a demonstration facility for the module fabrication and field-testing of a solar photovoltaic water-pumping system for agricultural applications. The Department also contributed to two solar pumping projects in Gambia which involved the testing of ground-water resources and the selection and testing of pumping systems, leading to a programme of large-scale diffusion.

8. The activities of the Food and Agriculture Organization of the United Nations (FAO) in the solar energy field have been concerned mainly with the promotion of promising technologies and the monitoring of systems appropriate for rural areas. Most of its activities in decentralized solar applications have been in solar drying systems. In Burundi, FAO was involved in a project for the storage and processing of food products, using solar energy, and in Sri Lanka, in the design, development and dissemination of small-scale paddy driers. Technical assistance was also provided to the Dominican Republic and Pakistan in the solar drying of agricultural products.

9. The United Nations Development Programme (UNDP) has carried out both solar pumping and solar photovoltaic activities. In El Salvador, it set up a photovoltaic-powered modular medical facility for remote areas. In Mali, it provided 10 solar photovoltaic water pumps and 250 manual water pumps. In Grenada, it installed solar water-heating systems in three hospitals; an ongoing project involves the design and construction of equipment and the training of staff in the same field.

10. The United Nations Children's Fund (UNICEF) has provided solar cookers and ovens to Burkina Faso, Ethiopia and Thailand. Somalia received solar ovens, cookers, a solar-operated water distillation plant and solar photovoltaic water pumps. UNICEF found that solar-powered refrigerators were an excellent solution to the problem of poor fuel quality and fuel shortages in remote areas where vaccines must be stored and the freezing of ice packs is required for "outreach immunization". Consequently, an extensive programme for photovoltaic refrigeration has been in operation since 1984, with regular increases since then. So far, UNICEF has supplied photovoltaic refrigeration to 17 countries and will extend the programme to other countries as well.

11. The activities of the United Nations Industrial Development Organization (UNIDO) aim at the establishment of facilities for detailed design, system engineering, prototype development, testing and pilot plant production of complete photovoltaic systems or components. In Afghanistan, UNIDO assisted in the adoption of photovoltaic technology by building up a pilot capability for manufacturing photovoltaic panels and introducing various solar energy devices. UNIDO also assisted the Indian Association for the Cultivation of Science (Calcutta) in developing laboratory technology for the manufacture of amorphous silicon photovoltaic cells to convert solar energy to electricity. The project has already installed a chemical vapor deposition chamber, which has produced samples of photovoltaic cells of high efficiency. A materials evaluation laboratory will be completed in 1992. The next phase, to be started in 1992, will aim at installing a pilot plant to develop the technology of larger cells. Another UNIDO project planned for 1992 - also in India - involves the establishment of solar photovoltaic-powered submersible water pumping systems, in order to provide drinking water to people in urban areas not connected to electricity grids. UNIDO is currently establishing a development centre for silicon technology in Pakistan. The project's objective is to create selected technology and expertise locally in support of the manufacture of photovoltaic cells and silicon-based industrial components for rural electricity supply, particularly in remote areas. In Jordan, assistance was given for the manufacturing of solar water heaters for industrial applications. UNIDO has also been assisting many countries in the production of salt by solar evaporation in Africa, Latin America and the Caribbean.

12. With regard to solar-specific multi-purpose medium- to large-scale applications, the Department of Technical Cooperation for Development provided assistance in the establishment of the Solar Energy Centre (India, 1987-1991). The Centre focused on solar thermal energy systems and system testing. In addition, the Department assisted in the transfer of solar thermal technologies to industry and in the drafting of national standards for the performance and testing of solar thermal devices.

B. Wind

13. Although certain United Nations bodies have been involved in the field of wind energy, no salient patterns have emerged. Most activities took place in the early 1980s, and a marked decrease is noticeable in recent years. The Department of Technical Cooperation for Development is mainly involved in demonstrating wind applications. In China, a project in Zhejiang and Fukien provinces tested the operational characteristics of different types of wind turbines, examined their integration into existing electric power systems and provided a modest supply of electrical energy for local needs. The Department has also demonstrated wind-powered pumping systems in Gambia, Mauritius, Mongolia and Cape Verde.

14. FAO has been involved mainly in using wind energy for sail power for fishing vessels. Projects in this field have been executed in India, Kiribati, Somalia and Tonga. UNDP has been involved in the development of the utilization of wind energy in Cape Verde where the national capacity for using such energy was created through the training of personnel in the design and implementation of wind power programmes. Additional wind energy was provided through the installation of wind turbines. UNDP also provided wind generators to Tokelau and Somalia.

15. The United Nations Environment Programme (UNEP) assisted in the installation and operation of wind-powered water pumps on Higatangan Island in the Philippines. UNICEF has also been involved in providing wind-energy-driven mechanical pumps to several countries, including Morocco, Viet Nam, Guyana and Somalia.

16. UNIDO has aimed at establishing local capabilities for the production and installation of wind energy systems for water pumping and electricity generation. In Ethiopia, wind turbines and hand-power pumps were installed at various well depths. The wind devices included vertical-axis and horizontal-axis rotors, the vortex pump and the Addis Rotor (a local development). Assistance was also provided in the local manufacture of an engine-powered piston pump for deep wells and hand-powered drilling rigs. In Kenya, UNIDO assisted in the construction of windmills and the manufacture of low-cost mechanical water-lifting devices for irrigation and water supply to rural communities. In Egypt, a project contributed to the manufacture of wind turbines for electricity generation. In Argentina, another project tested the viability of windmills in remote areas and a hybrid diesel/wind unit was established at Elcruz, Rio Negro, 10 additional sites were also identified in the Patagonia area. In Honduras, technical assistance is being provided for laboratory tests in adopting a wind generator for pilot production.

C. Hydropower

17. In terms of financial volume, hydropower has been dominant in the activities of the United Nations system regarding renewable energy sources. However, most of the dominance is due to the involvement of the World Bank, whose lending for hydropower during the period 1980-1988 amounted to a total of $5,145 million, or 26 per cent of all lending for electric power projects.

18. In small-scale decentralized hydropower activities, the Department of Technical Cooperation for Development has executed four projects in Ethiopia, which include the construction of 5-MW hydroelectric stations and associated transmission lines, substations and distribution lines. Sudan and Mozambique also received assistance from the Department in small-scale hydropower development.

19. The World Bank has provided financing for a limited number of small-scale projects, including private-sector manufacturing of hydro equipment by the Bank's affiliate, the International Finance Corporation (IFC). The projects entailed the construction of 31 hydroelectric plants in Romania. In Mali, the Bank financed the construction of mini-hydro projects, transmission lines and distribution networks. The Bank also financed a mini-hydro project in Thailand.

20. UNDP supported the installation and production of hydraulic ram pumps in the Lao People's Democratic Republic; in Nepal, assistance was provided for the construction of the Phewa Tal dam, including the design and provision of equipment for major dam facilities to generate 1,000 KW of electricity and irrigate 320 hectares of farmland. Elsewhere in Nepal, UNDP provided civil works and equipment for five mini-hydro projects. A project in Burundi consisted of the installation of a complete electrification distribution network and diesel generators to be connected to a hydropower plant. A more extensive project was carried out in Bhutan as part of a programme to develop small-scale hydropower plants nationwide. It aimed at providing electricity to the population of the Tashigang district in eastern Bhutan. A 1.12-MW hydropower station was constructed on the Kathiri River, and transmission lines, distribution lines and transformers were installed.

21. UNIDO has executed a number of mini-hydro projects, mainly in Africa. In Ethiopia, it gave technical assistance to a programme of construction of small hydroelectric power stations based on domestic production capabilities for equipment and components. In Burkina Faso, mini-hydro plants were utilized to electrify rural areas, in order to conserve forest resources. In Madagascar, UNIDO designed a mini-hydro plant at Andriantsemboka (1989-1992). It is planning to assist Kenya in constructing a hydropower plant at the Jua Kali units.

22. The Department of Technical Cooperation for Development was involved in two large hydropower projects financed by the Government of Italy. The projects were both in Africa - the Mandimba hydropower project in Mozambique, and the Mbulu hydropower scheme in the United Republic of Tanzania. UNDP also

assisted Mozambique and Zaire in the utilization of hydropower for industrial development. UNDP was involved in the rehabilitation of hydro-electric units at NamDong and Selabam in the Lao People's Democratic Republic. The project consisted of the removal of sediment near a generator-input spillway, masonry work for the restoration and protection of existing structures, and the complete rebuilding of the hydro-electric and thermally-driven generating units that supplement the network. In Bangladesh, UNDP supervised the construction of the Khulna power station.

23. Table 1 below shows the magnitude of the Bank's involvement in hydropower during the period 1980-1988. It may be noted that in recent years lending for this sector appears to be declining.

Table 1. World Bank Group lending for hydropower

Fiscal year	Amount loaned (millions of dollars)	Percentage of total lending for electric power
1980	780.9	32.6
1981	845.6	63.9
1982	106.8	5.0
1983	665.0	37.9
1984	1 124.0	42.4
1985	335.5	14.9
1986	379.8	13.6
1987	542.0	20.1
1988	365.6	20.0
1980-1988	5 145.2	26.0

Source: World Bank, Industry and Energy Department working paper, Energy Series No. 31 (Washington, D.C.).

D. Biomass

1. Alcohol

24. By far the largest project for the production of alcohol as a substitute for conventional petroleum products has been carried out in Brazil. The World Bank provided $550 million for the financing of the project during the 1980s. An affiliate of the World Bank, the International Development Association (IDA), also provided credits for alcohol projects in Bangladesh and Mali. UNIDO has assisted Chile, Paraguay and Thailand in national alcohol and methanol plans.

2. Biogas

25. The projects in this field mainly involve technical assistance and technology transfer in the area of biogas plants or digesters. The Economic and Social Commission for Western Asia (ESCWA) carried out an extensive project on biogas technology in Yemen, with financing from the Government of the Netherlands. The project involved the preparation of a set of alternative designs of biogas digesters appropriate to local conditions and the planning and supervision of two family-size biogas plants. FAO assisted India in the development of biogas technology for rural communities and contributed small-scale biogas units to Pakistan, Honduras and Burundi. UNICEF provided biogas plants to a number of countries, including Gambia, Guyana, India, Mali, Nepal, Peru, Senegal, Thailand and Turkey. While UNIDO executed an integrated biogas plant development project in the United Republic of Tanzania.

3. Biomass-general

26. All the activities in this area have been carried out by UNIDO, with the exception of two projects by the World Bank group. The World Bank financed the use of bagasse for power generation in Mauritius. The total cost of the project was $44.9 million. IDA assisted Mali in the construction of a 2-MW biomass plant and a distribution system as part of a larger project in institutional support. UNIDO provided technical assistance to Romania in applied bio-technology for power generation and assisted the Dominican Republic in producer gas technology. In India, assistance was given on the application of alternative fuels for internal combustion engines in Dehra Dun; in Colombia, in the selection of sugar cane by-products for energy; and in Brazil, on enzymatic hydrolysis of cellulosic materials and the production of other liquid fuels from biomass.

4. Charcoal

27. Most of the projects in charcoal production are combined with those for fuelwood, with emphasis on the latter. Among the projects involving only or predominantly charcoal, FAO assisted Burundi to improve charcoal production, and in Mozambique developed fast-growing species of forest plantations in order to provide fuelwood/charcoal for the Beira region. The World Bank carried out a project in the Philippines of watershed management and forestry enhancement, including reforestation, construction of charcoal ovens, pilot programmes in range management, smallholder agro-forestry and forest protection in two watershed areas. The goal was to increase wood supply to be used for charcoal production. IDA provided technical assistance in improved charcoal stoves in Burundi and executed an afforestation project in Bangladesh for fuelwood and charcoal production.

28. UNDP carried out a fuelwood and charcoal project in Sudan involving the production of fuel briquettes and the promotion of improved cooking stoves for households. In India, UNICEF installed 1,000 challahs and 4,000 smokeless challahs for charcoal and fuelwood production. In Sudan, UNIDO carried out a field-test programme for the production of charcoal from cotton stalks, using

small decentralized techniques. In Fiji, UNIDO managed a charcoal development and utilization project which involved the local production of low-cost cooking stoves for household, urban, rural and small industrial purposes, and in Paraguay introduced charcoal-production technology. UNIDO also provided technical assistance to Somalia on improvements to the charcoal-production industry; the focus was on improvements to traditional kilns and introduction of fire brick kilns.

5. Fuelwood

29. There have been many projects in the fuelwood sector, mainly in the establishment of fuelwood/tree plantations, woodlots and reforestation programmes. Most were carried out in the early 1980s. FAO executed a number of fuelwood projects, mostly in Africa. Fuelwood plantations and woodlots for rural energy supplies were established in Benin, Burkina Faso, Chad, Kenya, Mozambique, Senegal, Togo and Yemen.

30. The World Bank has carried out reforestation programmes in the Philippines and Zambia, provided technical assistance to Turkey on a forest management programme, and constructed a power plant based on waste wood in Guyana. Fuelwood plantations were established by the World Bank in Cameroon, India, the Ivory Coast, Jamaica, Kenya, Morocco, Nigeria, Peru and Sri Lanka, and IDA carried out similar activities in Bangladesh, Bhutan, Burkina Faso, Burundi, Cameroon, China, India, Madagascar, Nepal, Rwanda, Sri Lanka and the United Republic of Tanzania.

31. UNDP carried out a wood-based rural electrification programme in Samoa and forest development programmes in the Lao People's Democratic Republic and Somalia. Large-scale tree plantations were established in northern Sudan, and improved stoves were distributed in Malawi and Mauritius. UNICEF distributed improved cookstoves in Ethiopia, Gambia, Guyana, India, Kenya, Lesotho, Mauritius, Rwanda, Senegal, Somalia and Thailand. UNIDO gave technical assistance to Samoa on the production and use of efficient fuelwood stoves.

E. Geothermal

32. The Department of Technical Cooperation for Development, the World Bank group and UNDP have all been involved in geothermal applications. The Department has mainly provided expertise for basic geo-scientific surveys, exploratory drilling for feasibility studies, and reservoir engineering and management. In China, a project began in 1989 with the aim of developing geothermal resources in Tibet for power generation and direct use. During the next few years, the project will assess the physio-chemical characteristics of geothermal fluids at Nagqu with a view to installing a binary-cycle power generating unit. It will also explore two new promising areas for future development and further optimize the exploitation of the Yanbajin geothermal field, together with the production of the associated power plant. The Department assisted Honduras in geothermal engineering services, training and equipment. A feasibility study was being prepared in 1991. In India, a

project covered the exploration and development of geothermal resources for electricity generation and other industrial uses. In Kenya, three 15-MW units were commissioned, and a pre-feasibility study to extend geothermal exploration to new areas of the Rift Valley were completed. Follow-up activities have identified two areas for electrical power development.

33. Financing from the World Bank led to geothermal development in Kenya and in Yugoslavia. IDA provided credits for geothermal exploration in Kenya and Yemen. UNDP carried out geothermal exploration in India and executed a geothermal district-heating project in China.

II. PROMOTION OF RAPID AND EFFECTIVE TRANSFER OF TECHNOLOGY

34. Activities by the United Nations system in this area have been very limited. The examples cited below have all directly or indirectly led to the transfer of technology.

35. In the geothermal sector there are a few examples of multilateral cooperation. UNDP has funded about 40 geothermal exploration projects during the past 25 years in 25 developing countries worldwide, with the technical execution of the Department of Technical Cooperation for Development. Under UNDP-funded geothermal projects, a large number of professionals from many developing countries have received short-term specialized training during study tours at geothermal institutions (both public and private) in the developed countries. During the past five years, in geothermal projects executed by the Department, in Bolivia, China, Honduras, Kenya and the Philippines, extensive on-the-job training has been provided by foreign experts to a large number of national professionals. A total of 441 person/months of training abroad was provided to 104 national professionals from those five countries.

36. The United Nations Revolving Fund for Natural Resources Exploration (UNRFNRE), in a joint venture with the United States Agency for International Development (USAID), recently completed a deep exploration well during a geothermal project in St. Lucia, and the United Nations Training System for Science and Technology for Development, with a financial contribution from the Government of Italy, recently completed a geothermal exploration project in Costa Rica.

37. The World Bank initially financed only the power-plant component of geothermal projects but has now expanded its activities to include financing for exploration and development in a number of developing countries, such as Djibouti, Ethiopia, the Philippines and Yemen.

38. There are a few joint ventures in the World Bank's work in hydropower. The construction of a dam, reservoir and power station in Guyana was co-financed by the Central American Bank for Economic Integration and the Venezuelan Investment Fund. In Honduras, the Cajan Hydro power station was co-financed by the Inter American Development Bank, the Venezuelan Investment Fund and the Government of Japan.

39. ESCAP initiated a programme of technical and economic cooperation in the ESCAP region regarding small-scale hydropower, wood and wind energy. The programme included meetings of experts to discuss economic and technical cooperation, developing institutions and training to accelerate the application of renewable energy. It led to an exchange of photovoltaic technologies between Bangladesh, India, Maldives and Thailand.

40. The Investment Cooperation Programme Branch (ICPB) of UNIDO executed a project to explore opportunities for coordinating the production of renewable energy equipment. The project is aimed at promoting investment cooperation between developed and developing countries for the production of equipment in biomass and solar energy in developing countries. UNIDO also established an energy programme covering biomass and solar energy utilization, to include economic cooperation and technical cooperation among developing countries. The activities took place at the project-investment level and aimed at the local manufacture of equipment for the utilization and production of renewable energy.

41. There are a few cases of South/South cooperation promoted by UNIDO. UNIDO funded the demonstration of Chinese biogas technology in Madagascar. The project included training on the application of the technology. UNIDO also provided expert service on technical cooperation between Somalia and India in the field of windmills for water-pumping. It also instigated the transfer of technology from Brazil to Kenya in the field of alcohol production on the design, fabrication and testing of commercial distilleries. Assistance was also given to the Niger/Nigerian Joint Economic Cooperation Commission on solar, biomass and hydropower.

Notes

1/ Official Records of the General Assembly, Forty-fifth Session, Supplement No. 36 (A/45/36), annex.